DOCUMENT RESUME

ED 110 417 SP 009 397

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TITLE Quantity and Quality of Instruction: Empirical Investigations.
PUB DATE 75
NOTE 40p.; Paper presented at the Annual Meeting of the American Educational Research Association (Washington, D.C., March 31-April 3, 1975); Not available in hard copy due to marginal legibility of original document

EDRS PRICE MF-$0.76 PLUS POSTAGE. HC Not Available from EDRS.
DESCRIPTORS Academic Achievement; *Educational Quality; *Models; Program Length; Reading Achievement; *Reading Instruction; Research Methodology; *Teaching Quality; *Time Factors (Learning)

ABSTRACT

This paper discusses a study undertaken to examine the contributions of quantity and quality of instruction to reading achievement. Models of school learning by Wiley and Harnischfeger (W-H) were used in this study. The study sample consisted of fourth, fifth, and sixth graders who had complete data on the major variables under consideration and who had received any of levels one through six of the criterion referenced reading tests. Data on the quantity and quality of instruction were gathered in taped interviews given to all principals, teachers, specialists, and selected teacher aides. The analytical procedures in this study involved improving the data, reducing the number of relevant variables, and deriving the reading progress parameters. Results indicate that allocated exposure time is related to student performance, even while controlling for school, student, and teacher background factors. This suggests that further field exploration of the factors in the W-H model are feasible and will result in refinements of causal relationships. Results also indicated that extra time spent by the teacher with the student has an effect that is tied to student ability. (The data in this report is supported by 15 tables.) (RC)

Quantity and Quality of Instruction: Empirical Investigations*

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Quantity and Quality of Instruction

Models of school learning have been developed over the last decade. The more important models are those by Carroll (1963, 1970, 1973), Bloom (1968, 1974), and Wiley and Harnischfeger (1974). Carroll's model emphasizes the time a student needs to learn a task. The model takes the following form:

$$\text{Degree of Learning} = f\left(\frac{\text{time actually spent}}{\text{time needed}}\right)$$

This model induced laboratory research on time and learning. Bloom and his associates conducted related studies on mastery learning. However, the present report is more in line with the models proposed recently by Wiley and Harnischfeger.[1] These W-H models may be appropriate for both field and laboratory research. However, design and measurement problems increase dramatically from laboratory to field implementations of time studies.

The W-H model for individual instructional exposure and achievement is presented in Figure 1. Wiley and Harnischfeger state that "Achievement is directly determined by only two variables: total time needed by a pupil to learn a task (4) and total time a pupil actively spends on a given learning task (3)." Thus,

$$\text{Achievement} = f\left(\frac{WXY}{Z}\right)$$

where,

W is the total Allocated Exposure Time

X is the percent Active Learning Time, and

Y is the percent of Usable Exposure Time

Z is the total Needed Learning Time. (p. 11)

The parsimony of this final equation is attractive. However, is the symbolic conversion of student and program characteristics into time factors realistic?

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[1] Here after referred to as the W-H model(s).

Figure 2. Individual Instructional Exposure and Achievement *

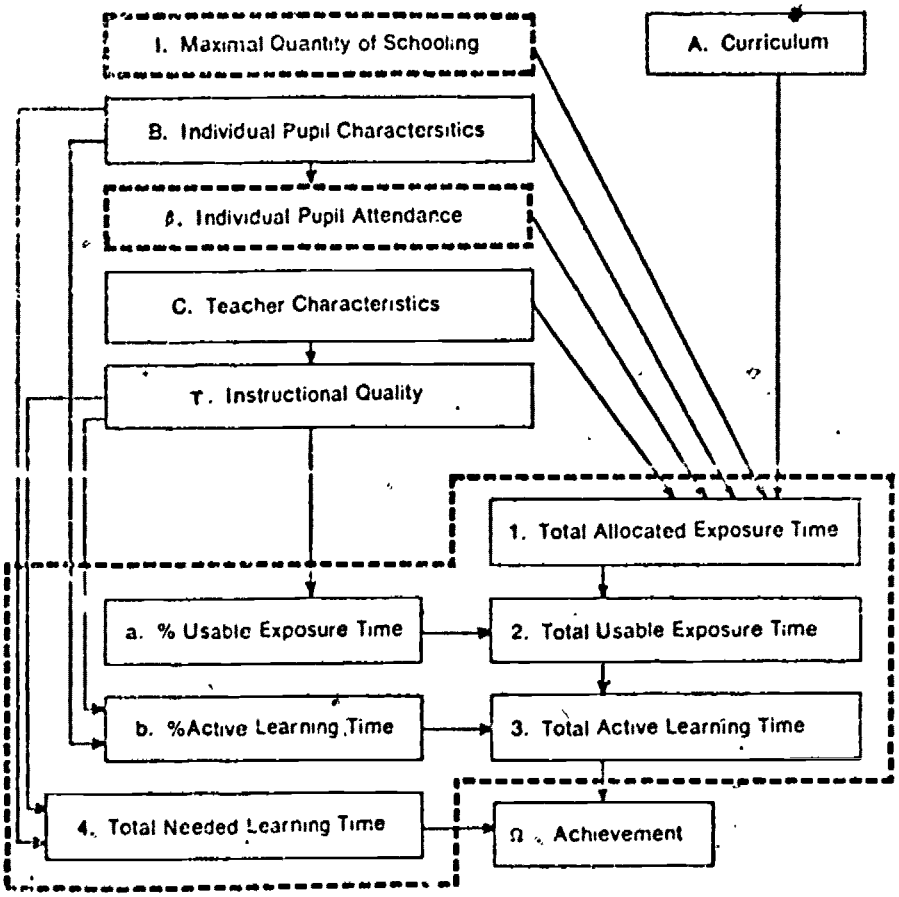

*Figure 2 from Wiley and Harnischfeger (1974), p. 10.

Can the direction and magnitude of the many relationships in the W-H model be determined? And most importantly, are the effects of these factors interactive?

The present study explored some of the implications of the W-H model for individual instruction in the context of an analysis of compensatory reading programs in grades 4, 5, and 6. The approach involved assessing the total time or quantity of reading instruction available to all students in the regular classroom and in additional reading programs usually based on Federal and/ or State aid. The approach allowed an assessment of the impact of time on achievement in regular reading instruction and in special reading programs. Concomitant with the assessment of time, selected qualitative conditions of instruction were analyzed. Variables defining the conditions of instruction included teacher age and classroom socio-economic status plus a unique index of the quantity and variety of instructional resources available. In addition, estimates of time available for reading instruction were obtained for four instructional modes: whole group, small group, individual help, and individualized.

In the context of studies done in school settings, the present analysis provides new data on the continuing conceptual and empirical exploration of the effects of quantity and quality of instruction on achievement. It must be added that the present study was designed and implemented before the W-H models were published. This prevents a definitive examination of the implications of the models. In addition, due to the complexity and diversity of the original data base, the analyses reported here do not fully exploit the data; they are designed to increase our understanding of the W-H model.

Focus of the Analysis

The general focus of the study was an examination of the contributions of quantity and quality of instruction to reading achievement.

tion concerning quantity was framed in the following way:

1. To what extent does time available for reading instruction contribute to reading achievement?

Instructional time was gathered by modes of instruction with the regular classroom teacher and with any additional reading treatments. The following additional questions could thus be evaluated:

2. To what extent does the contribution of time to achievement vary as a function of instructional mode?
3. To what extent does additional instructional time in reading outside the classroom contribute additional increments in reading achievement?
4. To what extent do the contributions of additional time in reading to achievement vary as a function of type of staff (reading specialist or aide)?

The question concerning instructional quality was framed in the following ways:

5. To what extent does the quality and quantity of instructional resources available in reading instruction contribute to reading achievement?

The Carroll and W-H models imply that both quantity and quality of instruction may interact with instructional time, the quality of instruction or other factors defining instructional conditions. These additional factors include teacher variables and characteristics of the student body. Therefore, additional questions concerning this type of interaction were framed as follows:

6. Is achievement a function of time in different modes of instruction and student aptitude?

...sent the initial focus of the study. The approach ma... ...the contribution of the other factors tradition- al... ...ch of this type. For convenience, these factors are summa... ...to the categories in the W-H model in Figure 1.

Individual Pupil Characteristics

1. Age
2. Father's Occupation

Individual Pupil Attendance

1. Percentage of Days Present (subsumed in the number of minutes per year of reading instruction)

Teacher Characteristics

1. Age
2. Degree Status

Instructional Quality

1. Index of Materials Resource Utilization
2. Instructional Mode (indicated by time in a particular mode)
3. Instructional Staff Type (measured as time with teacher, specialist, paid aide or unpaid)
4. Number of pupils
5. Percent white
6. Percent working poor/ unskilled

Total Allocated Exposure Time

1-4. Teacher time in whole group or small group instruction, individual help or individualized instruction.

5. Total Teacher Time
6. Total Specialist Time
7. Total Paid Aide Time
8. Total Unpaid Aide Time

Total Needed Learning Time

1. General student aptitude

2. Specific student aptitude

Achievement

1. Student performance on a norm-referenced reading test.

Preliminary investigations of these variables in the W-H model were based upon correlations and regressions on data from 4 school districts.

Method

Sample

The present analysis is based on a preliminary sample of 2516 Ss in four school districts as shown in Table 1. The study sample was drawn from an initial sample of 5 districts and a potential participating student sample of nearly 6,000 Ss. One district was lost due to incomplete achievement test data (N=72) while other Ss were removed in the development of subsamples.

Insert Table 1 about here

The study sample consists of 4th, 5th, and 6th graders who had complete data on the major variables under consideration and who had received any of levels 1-6 of the criterion referenced reading tests. Districts and schools were selected for variation in resource use in reading instruction. District A, for example, generally had a modest investment on added resources for reading instruction, but had a student population approximating the disadvantaged population in some urban districts. The remaining three districts were characterized by heavier investments in compensatary reading programs. Data were collected in the 4th, 5th, and 6th grades that had voluntarily participated in the experimental installation of the criterion referenced reading tests. Generally, this meant all classes in a school at the intermediate level whether or not that class had many Ss in compensatary reading programs.

Design

The design for data collection is summarized in Table 2. A longitudinal design was used to obtain repeated administrations of both norm

reference[illegible] measures of achievement over a three-year peri[illegible] criterion referenced tests were installed as alternative measu[illegible] achievement from January, 1974 to June, 1974. The present report, however, focuses on the norm referenced measures. To provide a basis for answering the major questions of interest, data on the quantity and quality of instruction as well as on other school factors were obtained during the period from January to June, 1974.

Insert Table 2 about here

A list of the variables included in the analyses of the W-H model is given in Table 3. A representative list of all original variables is provided in Table 4.

Insert Table 3 about here

Insert Table 4 about here

Data on the quantity and quality of instruction were gathered in taped interviews given to all principals, teachers, specialists, and selected teacher sides. This interview focused largely on obtaining estimates of the minutes per week of reading instruction over each of four instructional modes: whole group instruction, small group instruction, individual help, and individualized instruction. The interviewers allocated available instructional time for each student by mode within teacher and by mode within any additional reading treatments scheduled for a given student. Questions about time

gathered from all personnel involved and enabled a series of cross-checks on time estimates for any given student.

In addition to questions on time, the interview resulted in a record of all materials and equipment used as a resource in reading instruction. An index of materials resource utilization (IMRU) was developed to simultaneously quantify the extent of instructional resources available to a teacher, together with the extent of utilization of resources. To obtain an IMRU for each teacher, the interview record grouped instructional resources into four categories, one for each type of material used: 1) basal series, workbooks, and other skill builder supplements, 2) additional software, 3) hardware, and 4) teacher created materials. A score for each category was determined, based upon the number of materials used in that category and how they were used. In most cases, materials used as a major resource were given a value twice that given supplemental materials, such as additional workbooks. The IMRU was determined by taking the sum of the four scores derived for each category of materials. A brief description of each of the four scores making up the IMRU follows:

Materials Category #1. This score for basal series, workbooks, and other skill builder supplements was perhaps the most complex. For each basal series used, a value of 2 was added. A value of 1 was added for each workbook used in conjunction with a basal series. In addition, a value of 1 was added if one to three additional skill builder supplements were used, and a value of 2 if more than three of these skill builder supplements were used. The highest possible score allowed for Materials Category #1 was 12.

Materials Category #2. Additional software was grouped according to the number of obviously different resources used: less than 3, 3-6, and greater than 6. Values of 1,2, and 3 were assigned, respectively, when each group of different resources was used as supplemental resources. These values were doubled for groups used as major resources. If more than six major resources were used, a total maximum score of 9 was assigned.

Materials Category #3. In general there were nine different types of hardware used. A value of 2 was assigned to each type of hardware used as a major resource, while 1 was assigned to each type of hardware used as a supplemental resource. The highest possible score, the case in which all nine types of hardware were used as major resources, was 18.

Materials Category #4. The score for teacher created materials is similar to that of hardware. Values of 2 and 1 were assigned to each type of teacher created material used depending on whether it was a major or supplemental resource, respectively. Since there were five types, the highest possible scores was 10.

Total score on the IMRU was largely determined by materials categories 1 and 2, since, by comparison, values derived for categories 3 and 4 were generally low. It remains a problem for future analysis to determine how these various instructional resources may best be combined into one index.

Analysis

The analytical procedures were designed to answer the original research questions. The procedures involved improving the data, reducing the number of relevant variables, and deriving the reading program parameters.

Following a complete data edit, frequency distributions were obtained for all variables.[1] These distributions led to the conversion of all time variables into natural logs. Means, standard deviations and correlations were then calculated. Estimates with low variability were eliminated.

A principal components analysis with varimax rotation was then run on a large proportion of the raw data matrix, including selected multiplicative interactions. The resultant rotated factor structure accounted for just over 50% of the variation in the correlation matrix. The first four factors accounted for virtually all of this variation. Then factors in order of importance were small group instruction (23%), standardized achievement (16%), the teacher (9.4%), and whole group instruction (1.4%). A student background factor and individualized instruction accounted for additional small amounts of variation.

This study is consistent with the study data which showed that reading instruction among students varied most in amount of time in the small group mode. Even with the compensatory programs included, there was not much

1 When there were gross amounts (above 20%) of data missing for a variable, it was eliminated from the analysis.

variation [illegible] help and individualized modes of reading instruction. The [illegible] factor analysis led to a reduction in the number of variables included in subsequent analyses, as may be determined by comparing Tables 2 and 4. This analysis also showed that the two administrations of the CAT in January and June were virtually interchangeable. There was less than one-fourth of a standard deviation of change in the scores and they were highly intercorrelated (r = .86).

The result of the factor analyses further suggested that the aptitude x quantity or quality of instruction interactions could turn out to be important. The January CAT administration thus became the measure of specific aptitude which was used to define a series of interactions with different measures of instructional time.

With the number of variables reduced to a manageable set, a series of multiple regressions were calculated using the June CAT as the dependent variable. These regressions were organized to investigate the major study questions. The regressions were run in sets by district, with a separate analysis for each district. Each set of regressions included dummy codes for schools and a standard group of variables defining classroom conditions, the teacher factor, general aptitude of student, and student background. The measure of quality and quantity of instructional resources (i.e., the IMRU) included in each regression along with teacher was age and degree status. The specific estimates of instructional time were varied in each regression.

The significance of each factor in the regression equations was tested by computing a t for each b weight. Estimates of the practical significance of the various factors in a given equation were made on the basis of standardized regression weights. These weights allowed comparisons of the contribution of aptitude and quantity of instruction to achievement.

The results are organized first by correlations of the W-H model by district followed by regressions of these ... achievement within each district. As an aid in developing ..., interactions of time by student aptitude have been included.

Results

The W-H model suggests that student and teacher factors affect [illegible] allocated exposure time and total needed learning time, which subsequently impact on student achievement. From the beginning of the analyses, it was apparent that total allocated exposure time may hide interactions with student aptitude. Thus, total allocated exposure time was divided into the following components:

1. Teacher time in whole group instruction
2. Teacher time in small group instruction
3. Teacher time in individual help
4. Teacher time in individualized instruction
5. Total Teacher Time
6. Total Specialist Time
7. Total Paid Aide Time
8. Total Unpaid Aide Time

The means and standard deviations of these time factors and the variables entering into analyses is provided in Table 5 by district.

Insert Table 5 about here

As an initial exploration of the W-H model, it was divided into its major components. This division allowed a study of the relationship of the school and student variables to the allocated time variables. Following this, the school and student variables were related to general and specific student aptitude. These correlation studies provided some incentive for further analyses of allocated exposure time and needed learning time.

(Note that aptitude is considered a proxy for needed learning time in the analyses.)

Tables 6 and 7 contain the zero-order correlations of school and student variables with teacher time in whole group instruction and small group instruction, respectively for each school district. For comparison, Table 8 contains the zero-order correlations of the same variables with total specialist time.

Insert Table 6 about here

Insert Table 7 about here

Insert Table 8 about here

It is apparent that the relationship between specific allocated exposure times and the school and student variables is district specific. Generally, the expected relationships obtain for percent white and percent working poor/unskilled in the classroom. Interestingly, older teachers seem to spend less instructional time in the small group mode. The relationship between teacher's age and whole group instruction is significantly positive in three of the districts. Older teachers use whole group instruction more often.

In comparing whole group and small group instructional time, Districts A and B have an important pattern on percent working poor in the reading class. The more lower-SES students in class the less whole group instruction and the more small group instruction is used.

As one would expect, these districts vary greatly on instructional materials and how they are used. In District D, more materials are related positively to small group teacher instruction and negatively to whole group

teacher instruction. However, in District C the reverse holds. Thus, ther analyses of the impact of instructional materials on student ... ence will be required within each district.

Are school and student variables related to total teacher time? ... the relationships positive or negative? Several relationships between ... school and student variables for total specialist time were negative. Table 9 contains the correlations of selected school and student variables and total teacher time. In several districts, definite relationships emerge.

Insert Table 9 about here

For example, in both Districts B and D, total teacher time is related positively to quantity of instructional materials used and negatively to teacher age. There is also a slightly negative relationship between total teacher time and percent working poor/unskilled in each reading class. The more whites in a class, in general, the more teacher time.

It is clear that some school and student factors are directly related to allocated time. For example, a district with more resources may use small group teacher instruction. Larger classes or classes with experienced teachers may have less small group instruction.

Because achievement may also be related to total needed learning time, the following question can be asked: Are school and student factors related to total needed learning time? Needed time is not available in the present analysis. However, needed learning time is directly related to aptitude or ability. This may be used as a proxy for needed learning time. The relationship between the school factors and a measure of general reading ability (actually a pre-test in the present design) is presented in Table 10 and specific reading ability in Table 11. It should be noted that the general ability measure was administered to all of the 4th, 5th, and 6th grade students when they passed through 3rd grade. The specific measure of reading performance was administered to all students during January, 1974.

In subsequent analyses, both measures are used as [illegible] ability.

Insert Table 10 about here

Insert Table 11 about here

If aptitude is an acceptable proxy for "time needed for learning," the variables in the W-H model that might impact an "time needed" would include student age, Father's occupation, the IMRU, number of minutes in reading class, percent white and percent working poor. If reference is made to Tables 10 + 11 it becomes apparent that needed learning time (as measured by pretests of general and specific ability) is related to school and student variables. These tables imply that studies of the impact of allocated time and needed time must take into accountthe student's age and socio-economic status, number of students in the reading class, percent white and percent working poor/unskilled in the classroom.

Having noted that some of the factors in the W-H model are related to allocated exposure time and needed learning (defined as aptitude in the present analysis), it was possible to study the relationship of allocated exposure time and needed learning time to final student reading achievement. The zero-order correlations of allocated exposure time and aptitude to final student achievement is presented in Table 12 .

Insert Table 12 about here

With reference to Table 12, it becomes apparent that the correlation between the time factors and final student achievement may not be linear.

Are there [illegible] the data? Table 13 shows the zero-order correlations (i.e. treatment) interactions for total whole group, small group, individual help, and individualized instruction for the four districts.

Insert Table 13 about here

The district specific interactions of aptitude by time suggest that an analysis of the simultaneous effects of these factors may result in significant interactions of time by aptitude on student achievement. Table 14 contains a regression analysis of final student achievement on the selected factors in the W-H model. This analysis helps clarify the time effects and their interactions with aptitude while holding constant the other factors known to effect student performance. Table 14 contains only raw regression coefficients because comparisons are being made across districts. School effects within each district are being controlled for by the use of dummy school variables.

Insert table 14 about here

The regression estimates of the effects of time and aptitude by time are "unique" in the sense that the student, teacher, classroom, and school factors are controlled for in each equation.

The significant time effects occur mostly with specialist, paid aide, or unpaid aide time. This instructional time is in addition to teacher instructional time. The interaction effect that is significant in two districts is for aptitude by time for individualized instruction (II). The reading time provided by the specialist was coded as individualized or small

group instruction. The [illegible] interaction effect of apptitude by II time reflects instruction by [illegible].

The significant negative interaction of aptitude by II time can be interpreted within reason because they have been calculated from positive and negative z-scores on each interacting variable. Thus, the following relationships occured in the analyses:

Sign of Regression Weight	x	Aptitude	x	Time	=	Theoretical Effect on Final Achievement
-		-3.0 (low)		-3.0 (low)		-9.0 (low)
-		-3.0 (low)		+3.0 (high)		+9.0 (high)
-		+3.0 (high)		-3.0 (low)		+9.0 (high)
-		+3.0 (high)		+3.0 (high)		-9.0 (low)

The significant negative interaction of aptitude by individualized instruction can be interpreted as follows: (1) high aptitude and high time or low aptitude and low time are the "worst" combinations for achievement, (2) low aptitude and high time or high aptitude and low time seem to facilitate achievement.

The relative effects of the variables in this model of student achievement are indicated by the standardized regression estimates in Table 15. The interpretation of relative effects is restricted to each specific district.

Insert Table 15 about here

Within each district, the relative importance of the more salient time effects is as follows:

District A	District B	District C	[illegible]
Total Paid Aide (+)	Total Paid In's (-)	Total Paid Aide (-)	[illegible] Specialist (+
Pre-CAT by SGI In's (-)	Total Specialist (-)	Teacher's SG In's. (+)	[illegible] WG In's (-)
Pre-CAT by GvG In's (-)	Pre- CAT by Ind. In's (-)	Teacher In'd. Help (+)	Teacher In'd. In's (-)
Teacher In'd. Help (+)	Teacher In'd. Help (-)	Total Specialist (-)	Teacher W G In's (-)
Teacher W G In's. (+)	Teacher W G In's (+)	Pre-CAT by Ind. In's. (-)	Pre-CAT by S G In's. (-)
Pre-CAT by In'd. Help (+)	Teacher S G In's. (+)	Pre-CAT by S G In's (+)	Pre-CAT by Ind. Ins. (-)

In general, additional instructional time (i.e. above teacher time) interacts negatively with student ability. This leads to the interpretation noted previously but raises a final question on the nature of the effect of total teacher time. For example, is total teacher time a significant instructional time variable? Is the interaction of total teacher time by student aptitude significant? Table 16 contains the full regression model for student achievement plus total teacher time.

Insert Table 16 about here

Regressions were also completed with total teacher time plus the interaction of total teacher time by student aptitude. These combined analyses resulted in non-significant interactions and a slight improvement of the linear effect. Portions of the total teacher effect interact positively with student aptitude. This is in sharp contrast to the significant, negative interactions for specialist and paid aide time noted previously.

Conclusions

Due to the fact that the W-H model and the present study [illegible] parallel efforts, it was impossible to explore in detail some of the specific variables in the W-H model. However, the W-H model seems simplistic in the sense that the importance of interactions of allocated time by student aptitude are not clarified nor are the reductions in total allocated time by % Usable Exposure Time and % Active Learning Time clarified as improving the prediction of achievement. That is to say, is simply reducing the total allocated exposure time by a percent going to improve the prediction of achievement?

These analyses do suggest that allocated exposure time is related to student performance, even while controlling for school, student, and teacher background factors. In one sense, the present analyses are very conservative. Two controls for ability were used and yet the time effects still came through. These time effects were generally positive for the linear effects of total teacher time and negative for the linear and interaction effects for the added time variables. There are some district specific departures from this pattern with a negative contribution for whole group teacher time and a positive contribution for small group teacher time.

These models of student achievement accounted for 75 to 80 percent of the variation in final reading achievement. Initial studies without strict controls on student ability resulted in lower proportions of variance. The intent has been to present models that will hold up under different analytical schemes to be applied in the future.

This study suggests that further field explorations of the factors in the W-H model are feasible and will result in refinements of causal relatopnships. However, these field studies will be expensive and will have to

be district or school specific due to the obvious district variation found in the present analyses. Probably the second most important point in subsequent analyses will be the clarification of the interaction of additional instructional time with student ability. The present study suggested that time above that of the teacher has an effect that is tied to student ability. In fact, additionad time by the teacher may only be cost-effective with low and middle ability students. Low time with low ability students and high time with high ability students may not be paying off for time above a certain point. Further studies should be designed to determine optimum student ability-instructional time-performance combinations in the school setting.

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Table 1

Sample Characteristics for Each District in the Analyses (N=2516)

Variables	District A	B	C	D
No. Pupils	567	947	479	523
No. Schools	2	7	5[a]	3
No. Teachers	36	56	60	25
Type District	Suburban	Urban	Urban	Urban
% White	89%	83%	88%	63%
% Lower Status	25%	36%	59%	37%

[a]This number reflects two schools which are not in the analysis. These two additional schools have higher proportions of white and upper status students, thus making District B more comparable to the other districts in the sample than appears at this stage of the analyses.

Table 2

Design for Data Collection

	May 1973	Pre-1974	February 1974	March 1974	April 1974	May 1974	June 1974
Test Administrations:							
PEP[a] Test		X					
CAT[b]	X[d]		X				X
CRT[c]				X	XX	XX	
Reading Program Data Gathered via Interviews and School Records				X	X	X	X

Figure 3. The Design for Data Acquisition.

[a] Pupil Evaluation Program (PEP) norm-referenced tests of reading and mathematic's developed by the Bureau of Pupil Testing and Advisory Services at the New York State Education Department. These tests are administered in grades 3 and 6.

[b] California Achievement Test (CAT). Note that up to 3 levels and 2 forms of the CAT were used in the schools.

[c] Criterion-Referenced Test (CRT). Note that up to 8 difficulty levels and 5 forms within each level were available to the schools for testing with this experimental device.

[d] These data are available on a sub-sample of the total sample.

Table 3

Variables Included in the Regression Analysis

Variable No's. by District				Variable Name
A	B	C	D	
1	1	1	1	Student age
2	2	2	2	Father's occupation[a]
3	3	3	3	PEP raw score (Total reading score in 3rd grade)
4	4	4	4	Number pupils in class
5	5	5	5	Teacher degree status
6	6	6	6	IMRU (Index of materials and resource utilization)
7	7	7	7	Post California Achievement Test Total Reading
8	8	8	8	Dummy for school 1
	9	9	9	Dummy for school 2
	10	10		Dummy for school 3
	11	11		Dummy for school 4
	12			Dummy for school 5
	13			Dummy for school 6
9	14	12	10	Teacher age
10	15	13	11	% white in class
11	16	14	12	% working poor
12	17	15	13	% unskilled
13	18	16	14	% skilled blue collar
14	19	17	15	% skilled white collar
15	20	12	16	% business
16	21	19	17	% professional
17	22	20	18	Log minutes per year whole group teacher[b]
18	23	21	19	Log minutes per year small group teacher
19	24	22	20	Log minutes per year individual help teacher
20	25	23	21	Log minutes per year individualized instruction teacher
21	26	24	22	Log total minutes per year small group instruction
22	27	25	23	Log total minutes per year individual help
23	28	26	24	Log total minutes per year individualized instruction
24	29	27	25	Log total minutes per year total teacher
25	30	28	26	Log total minutes per year specialist
27	31	29	27	Log total minutes per year paid aide
27	32	30	28	Log total minutes per year unpaid aide
28				Jan. 74 California Achievement Test Total Reading (CAT)
33				Jan. 74 CAT x whole group instruction
34				Jan. 74 CAT x small group instruction
35				Jan. 74 CAT x individual help
36				Jan. 74 CAT x individualized instruction
37	Classroom socioeconomic status index			

[a] Eventually deleted and replaced with classroom SES on which data were complete.

[b] All time variables were log transformed.

Table 4

Original Variable List Used in Principal-Components Analysis

No.	Name
	Time and Time by Mode and Study
1.	Total Reading Instruction
2.	Whole Group Instruction (WGI)
3.	Small Group Instruction (SGI)
4.	Individual Help (IH) in Reading
5.	Individualized Instruction (II)
6.	All Specialist Reading Instruction
7.	All Paid Aide Reading Instruction
8.	All Unpaid Aide Reading Instruction
9.	Whole Group Instruction by the Teacher
10.	Small Group Instruction by the Teacher
11.	Individual Help by the Teacher
12.	Individualized Instruction by Teacher
	Materials
13.	Index of Materials Resource Utilization
	Student Characteristics
14.	Age
15.	Sex
16.	Birth Order
17.	Father's Occupation
18.	Father's Education
19.	Mother's Occupation
20.	Mother's Education
21.	3rd Grade Reading Ability (PEP TEST)
22.	Number of Days Absent
23.	Percentage of Days Present
24.	Membership in a Specific Reading Class
25.	Membership in a Specific School
26.	Raw Score on 1st Test Adm. at CRT Lev. 4
27.	Raw Score on 1st Test Adm. at CRT Lev. 5
28.	Membership in a Specific District
	Teacher Characteristics
29.	Age
30.	Sex
31.	Degree Status
32.	Total Years of Experience
33.	Type of Appointment
34.	Teacher Expectancy of Student Performance under real conditions
35.	Teacher Expectancy of Student Performance under ideal conditions
36.	Ideal minus Real Teacher Expectancy
37.	No. of Undergraduate Courses Related to Rdg.
38.	No. of Graduate Courses Related to Reading
39.	No. of Inservice Hours/Month
40.	Minutes per week (MPW) Preparation for Reading
41.	Min. P/W of Teacher Coordination Time for Rdg.
42.	MPW Coordination for Read.
43.	Teacher absence
	MPW Non-Instructional Reading Activities

No.	Name
	Student Body Characteristics
44.	No. of Students in Reading Class
45.	Percentage of White Students
46.	Percentage of Black Students
47.	Percentage of Spanish Surnamed Students
48.	Frequency of Change in Reading Group Com
49.	Percentage Working Poor or Unemployed
50.	Percentage Unskilled Workers
51.	Percentage Skilled Blue Workers
52.	Percentage Skilled White Collar
53.	Percentage Management Level
54.	Percentage Professional
55.	No. Absences/day from reading class
56.	Mobility "in" and "out"
57.	Voc., Comp., Total ADSS on Jan.,1974 C.A
58.	Membership in High-C.A.T. Ability Group
59.	Membership in High-Middle C.A.T. Ability
60.	Membership in High-PEP Ability Group
61.	Membership in High-Middle-Pep Ability Gr
	School Characteristics
62.	/Ability Grouping Practices
	Interactions
63.	High Performing Students by MPW WGI, SGI IH, II by the Teacher
64.	MPW Total Reading Inst. by Student Sex, Age, No. of Days Absent, No. of Pupils in Redg Class, High and Low Performing Students, and Teacher Experience
65.	Student Sex by Teacher Sex
66.	Teacher Age by Teacher Age
67.	Teacher Experience by Teacher Experience
68.	Instructional Materials by High Performi Students, Low Performing Students, Teacher Preparation Time, and Teacher Ye Experience.
	Performance Measures
69.	Raw Score (plus 400) on 4th Test Adm., CRT Lev. 4
70.	Raw Score (plus 500) on 4th Test Adm., CRT Lev. 5
71.	Student Voc. ADSS on June 1974 CAT
72.	Student Comp. ADSS on June 1974 CAT
73.	Student Total Reading ADSS on June 1974 CAT

Table 5

Means and Standard Deviations[a] of Selected and Implied School Variables in the W-H Model of Student Achievement

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Student Age	21.78 (1.71)	22.20 (2.00)	21.91 (2.27)	21.57 (1.93)
Student PEP Ability[b]	32.93 (10.45)	28.07 (10.24)	---	30.68 (10.14)
Student CAT Ability[c]	.00 (1.00)	.00 (1.01)	.00 (1.00)	.00 (1.00)
Teacher's Age	43.49 (9.60)	39.65 (12.15)	28.60 (7.45)	37.19 (9.79)
Teacher's Degree Status	6.85 (.80)	6.01 (1.08)	5.86 (.91)	5.53 (.75)
Number Pupil's in Class	30.97 (4.26)	24.61 (4.64)	20.81 (4.10)	25.15 (4.32)
Percent White	89.03 (8.71)	83.02 (18.15)	28.17 (28.71)	63.95 (32.75)
Percent Unskilled	25.97 (16.65)	37.22 (37.51)	60.14 (35.08)	38.09 (30.92)
In's. Materials Index	9.14 (3.14)	11.33 (4.16)	10.33 (4.01)	10.92 (3.31)
School Effect A	.57 (.50)	.11 (.31)	.41 (.49)	.47 (.50)
B	---	.20 (.40)	---	.19 (.40)
C	---	.06 (.24)	---	---
D	---	.18 (.38)	.38 (.49)	---
E	---	.17 (.38)	---	---
F	---	.07 (.26)	---	---
Time Variables[d]				
Teacher Whole Group Ins.	5.93 (2.81)	5.42 (2.91)	5.50 (3.11)	4.39 (2.70)
Teacher Small Group Ins.	7.82 (2.26)	7.53 (2.37)	7.81 (2.48)	7.29 (3.12)
Teacher Individual Help	2.63 (.91)	3.09 (1.40)	2.62 (.97)	3.45 (1.70)
Teacher Ind. Instruction	2.30 (.00)	2.74 (1.56)	2.91 (1.94)	3.08 (2.18)
Total Teacher Time	8.89 (.69)	8.59 (1.50)	8.83 (1.78)	8.91 (1.25)
Total Specialist Information	2.52 (1.01)	3.37 (2.27)	2.85 (1.57)	3.41 (2.35)
Total Paid Aide Ins.	2.30 (.00)	2.88 (1.77)	3.50 (2.36)	2.70 (1.42)
Total Unpaid Aide Ins.	2.39 (.68)	2.36 (.56)	2.47 (.98)	2.41 (.73)
Interactions[e]				
Pre-CAT by WG Ins.	- .09 (1.05)	.20 (1.00)	.05 (1.01)	.05 (1.07)
Pre-CAT by SG Ins.	- .10 (.86)	- .13 (1.10)	.11 (.79)	- .33 (1.05)
Pre-CAT by Ind. Help	- .10 (1.14)	- .14 (1.05)	- .19 (.86)	.13 (1.03)
Pre-CAT by Ind. Ins.	- .06 (1.50)	- .27 (1.01)	- .18 (.91)	- .06 (1.01)

Note: A "---" in this table indicates variable does not apply or was not available in district.

[a] Standard deviations are in parentheses.
[b] PEP tests are statewide ability tests given in 3rd and 6th grades in New York State
[c] Total Achievement Development Scale Scores on the reading portion of the California Achievement Test-1970-norms.
[d] All time variables are natural log transformations of minutes per year per studnet.
[e] All interactions involve variables in z-score form.

Table 6

Zero-Order Correlations Between W-H Model Factors and Teacher Time in Whole Group Instruction by School District

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Student Age	-.22*	.14*	.10	.10
Father's Occupation	.03	-.02	.07	.02
Teacher Age	.12*	.05	.25*	.23*
Teacher Degree Status	.07	.44*	.08	.35*
IMRU	.15*	-.05	.29*	-.66*
Number Pupils In Reading Class	-.12*	.18*	.01	.15*
Percent White In Reading Class	-.13*	.09	.14*	-.19*
Percent Working Poor In Reading Class	-.39*	-.14*	-.06	.14*

*p < .05.

Table 7

Zero-Order Correlations Between W-H Model Factors and Teacher Time in Small Group Instruction by School District

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Student Age	.14*	- .08	- .01	- .50*
Father's Occupation	- .06	.03	.11 *	.15*
Teacher Age	- .30*	- .07	- .39 *	- .24*
Teacher Degree Status	- .09	- .08	- .21 *	.07
IMRU	.15*	- .04	- .16 *	.59*
Number of Pupils in Reading Class	- .19*	- .26*	.11 *	- .13*
Percent White in Reading Class	- .07	.02	.01	- .03
Percent Working Poor/ Unskilled in Reading Class	.34*	.15*	- .10	- .03

* $p < .05$.

Table 8

Zero-Order Correlations Between W-H Model Factors and Total Specialist Time by School District

Variable	District A[a] (N=567)	B (N=947)	C (N=479)	D (N=523)
Student Age	—	.08	-.04	.03
Father's Occupation	—	-.10*	-.07	-.10
Teacher Age	—	-.03	.10	-.01
Teacher Degree Status	—	-.06	.02	.06
IMRU	—	-.12*	.11*	.09
Number of Pupils In Reading Class	—	-.20*	.04	.04
Percent White In Reading Class	—	-.28*	-.20*	-.10
Percent Working Poor/ Unskilled in Reading Class	—	.26*	-.08	.12*

[a]There was no variation on Total Specialist Time in this district.

* $p < .05$.

Table 9

Zero-Order Correlations Between W-H Model Factors and Total Teacher Instructional Time by School District

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Student Age	-.10	-.01	-.05	-.19*
Teacher Age	-.04	-.14*	.05	-.16*
Teacher Degree Status	.03	.14*	-.04	-.01
IMRU	.14*	.21*	.03	.17*
Number Pupils in Reading Class	-.04	.11*	.04	-.11*
Percent White in Reading Class	.05	.03	.22*	.14*
Percent Working Poor in Reading Class	-.07	-.16*	-.01	-.11*

*p < .05.

Table 10

Correlations of the School Factors With 3rd Grade PEP[a] Reading Scores by District

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Student Age	-.08	-.15*	—	-.06
Father's Occupation	.12*	.19*	—	.32*
Teacher Age	-.01	.12*	—	.06
Teacher Degree Status	.02	.01	—	.06
IMRU	.14*	.03	—	-.02
Number of Pupils in Reading Class	.09	.25*	—	.11*
Percent White in Reading Class	.08	.26*	—	.41*
Percent Working Poor/ Unskilled in Reading Class	-.06	-.24*	—	-.27*

Note: A dash indicates that the variable does not apply to that district or was not available for that district.

[a]PEP is a general ability test given in New York State in 3rd and 6th grade.

* $p < .05$.

Table 11

Zero-Order Correlations of the School Factors with Total Pre-CAT[a] Reading Scores by District

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Student Age	.35*	.18*	.17*	.26*
Father's Occupation	.15	.23*	.31*	.46*
Teacher Age	.09*	.11*	.06	.25*
Teacher Degree Status	.17*	.19*	- .01	- .09
IMRU	- .11*	.02	- .04	- .18*
Number of Pupils in Reading Class	.18*	.24*	.43*	.08
Percent White in Reading Class	.28*	.26*	.49*	.59*
Percent Working Poor/Unskilled in Reading Class	- .09	- .29*	- .23*	- .43*

[a]California Achievement Test total Achievement Development Scale Score. This score is considered a pre-test score in the research design.

* $p < .05$.

Table 12

Order Correlations of Allocated Exposure Time
and Student Reading Achievement[a] in Four School Districts

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Time in Minutes per Year[b]				
Whole Group Teacher	- .07	.18*	.07	.07
Small Group Teacher	- .07	- .04	.15*	- .29*
Individual Help by Teacher	- .09	- .09	- .03	.31*
Individualized Ins. Teacher	.00	.02	- .01	.14*
Total Small Group Ins.	- .09	- .13*	.14*	- .30*
Total Individual Help	- .07	- .15*	- .18*	.13*
Total Individualized Ins.	- .07	- .27*	- .16*	- .13*
Total Teacher Ins.	.00	.11*	.19*	.07
Total Specialist Ins.	- .22*	- .35*	- .22*	- .32*
Total Paid Aide Ins.	.00	- .33*	- .21*	- .09
Total Unpaid Aide Ins.	.01	- .11*	- .04	- .18*
Aptitude				
3rd Grade PEP Test	.53*	.60*	—[c]	.54*
January, '74 CAT	.87*	.88*	.84*	.88*

[a]Achievement as measured by the June, 1974 Total Achievement Development Scale Score in reading on the California Achievement Test.

[b]All time variables are in natural log form.

[c]Not available in this district.

Table 13

Zero-Order Correlations of Aptitude by Time Interactions and Final Student Reading Achievement in Four School Districts

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Pre-CAT[a] by Total Whole Group In's.	- .24*	- .09	.19*	.13*
Pre-CAT by Total Small Group In's.	.10	- .05	.25*	- .24*
Pre-CAT by Total Individual Help	.10	.00	- .19*	.15*
Pre-CAT by Total Individualized In's.	.07	.06	- .13*	.03

[a]California Achievement Test; total Achievement Development Scale Score on CAT pretest.

*$p < .05$.

Table 14

Regression Estimates of Final Student Performance Based on Selected School Variables in the W-H Model of Student Achievement

Variable	A (N=567)	B (N=947)	C (N=479)	D (N=523)
Constant	308.44	398.50	283.54	371.79
Student Age	1.05	.89	- .37	1.07
Student PEP Ability[a]	.50*	.79*	—	.64*
Student CAT Ability[b]	49.80*	52.81*	46.73*	51.68*
Teacher's Age	.05	.04	.19	.45*
Teacher's Degree Status	3.06	-.83	.53	2.63
Number Pupils in Class	.27	.12	1.28	.96
Percent White	.73*	.11	.77*	.12
Percent Unskilled	.12	.02	-.01	.01
In's. Materials Index	.17	.24	.81	-.41
School Effect A	-1.20	-1.97	43.93*	-14.25
School Effect B	—	3.26	33.61	3.53
School Effect C	—	10.81	—	—
School Effect D	—	10.04*	—	—
School Effect E	—	5.71	—	—
School Effect F	—	10.83	—	—
Time Variables[c]				
Teacher Whole Group Ins.	.46	.50	.45	-2.01
Teacher Sm. Group Ins.	.29	.70	1.38	-.96
Teacher In'd Help	1.06	-1.75	2.51	.22
Teacher In'd Ins.	—	.67	-.55	-2.58*
Total Specialist Ins.	—	-2.30*	-1.78	-3.56*
Total Paid Aide Ins.	—	-3.11*	-1.71*	.57
Total Unpaid Aide Ins.	2.54	-2.21	1.71	5.63*
Interactions[d]				
Pre-CAT by WG Ins.	-1.38	-1.37	.65	-6.00*
Pre-CAT by SG Ins.	-2.27	-1.46	2.34	-3.73
Pre-CAT In'd Help	1.02	.22	-2.68	1.75
Pre-CAT by In'd. In's.	.33	-4.65*	-3.08	-3.84
R	.88	.89	.87	.90
R^2	.78	.80	.75	.81

Note: A " — " in this table indicates that the variable does not apply to that district or was not available in that district.

[a] PEP tests are statewide ability tests given in 3rd and 6th grades in New York State.

[b] Total Achievement Development Scale Scores in reading on the California Achievement Test- 1970 norms. This is a pretest, control for ability.

[c] All time variables are natural log transformations of minutes per year per student.

[d] All interactions involve variables in z-score form.

* $p < .05$ for t values.

Standardized Regression [illegible] Achievement
Based on Selected and Implied School Variables [illegible] of Student Achievement

Variable	District A (N=567)	District B (N=947)	District C (N=479)	District D (N=523)
Student Age	.03	.02	-.01	.03
Student PEP Ability[a]	.08*	.11*	---	.09*
Student CAT Ability[b]	.78*	.74*	.68*	.69*
Teacher's Age	.01	.01	.02	.06*
Teacher's Degree Status	.04	-.01	.01	.03
Number Pupils in Class	.02	.01	.08	.06
Percent White	.10*	.03	.32*	.05
Percent Unskilled	.03	.01	-.01	.00
Ins. Materials Index	.01	.01	.05	-.02
School Effect A	-.01	-.01	.31*	-.10
School Effect B	---	.02	.23	.02
School Effect C	---	.04	---	---
School Effect D	---	.05*	---	---
School Effect E	---	.03	---	---
School Effect F	---	.04	---	---
Time Variables[c]				
Teacher Whole Group Ins.	.02	.02	.02	-.07
Teacher Small Group Ins.	.01	.02	.05	-.04
Teacher Individual Help	.02	-.03	.04	.00
Teacher In'd. Instruction	---	.01	-.02	-.08*
Total Specialist In's.	---	-.07*	-.04	-.11*
Total Paid Aide In's.	---	-.08*	-.06*	.01
Total Unpaid Aide In's.	.03	-.02	.02	-.05*
Interactions[d]				
Pre-CAT by WG In's.	-.02	-.02	.01	-.09*
Pre-CAT by SG In's.	-.03	-.02	.03	-.05
Pre-CAT by In'd. Help	.02	.00	-.03	.02
Pre-CAT by In'd. In's.	.01	-.07*	-.04	-.05

Note: A "---" in this table indicates that the variable does not apply to that district or was not available in that district.

[a]PEP tests are statewide ability test given in 3rd and 5th grades in New York State.

[b]Total Achievement Development Scale Scores in reading on the California Achievement Test -- 1970 norms.

[c]All time variables are natural log transformations of minutes per year.

[d]All interactions involve variables in z-score form.

*p < .05 for computed t values.

Table 16

Regression Estimates of Final Student Achievement Based on Selected Model Variables and Total Teacher Instructional Time by School District

Variable	District A (N=567)	B (N=947)	C (N=479)	D (N=523)
Constant	345.05	368.01	290.02	305.54
Student Age	1.05	.71	-.25	1.15
Student PEP Ability[a]	.50*	.89	—	.75*
Student CAT Ability[b]	49.98*	55.44*	49.84*	55.45*
Teacher's Age	.10	.07	.18	.44*
Teacher's Degree Status	2.67	.19	.02	1.95
Number Pupils in Class	-.05	.20	1.59	1.25*
Percent White	.69*	.05	.66*	-.04
Percent Unskilled	.12	-.01	-.02	.01
In's. Materials Index	.41	.23	.32	.40
School Effect A	-3.53	-4.99	40.60*	-20.92*
School Effect B	—	-.02	29.21	-.13
School Effect C	—	9.32	—	—
School Effect D	—	5.76	—	—
School Effect E	—	4.02	—	—
School Effect F	—	9.64	—	—
Time Variable[c]				
Total Teacher Time	-1.06	1.59*	1.36	2.03
R	.88	.89	.86	.89
R^2	.77	.79	.74	.80

Note: A "-" indicates variable does not apply or was not available in district.

[a]PEP tests are statewide ability tests given in 3rd and 6th grades in New York State.

[b]Total Achievement Development Scale Scores in reading on the California Achievement Tests — 1970 norms.

[c]Time variable is in natural log form.

* $p < .05$ for computed t values.